Source: http://solar.physics.montana.edu/wangtj/link/radio/burst_old.html

CSIRO Division of Radiophysics in 1966 and was operated as a research instrument in conjunction with the Culgoora radioheliograph until the latter was decommissioned in 1984.

Recognising the value of the spectrograph in forecasting the terrestrial effects of solar activity, IPS Radio and Space Services stationed an observer at Culgoora in 1971. IPS expanded their solar monitoring capabilities with the construction of an optical observatory at Culgoora in 1978. It was to this facility that the spectrograph was moved when its operation was transferred to IPS in 1984. After this time, IPS operated the spectrograph with all the data being recorded directly onto thermal paper as a plot of time verses frequency.

Several factors prompted IPS to upgrade the radiospectrograph. Firstly, there was a deterioration in reliability resulting in down time. Secondly, by improving the spectrograph's resolution in frequency, time and intensity, a more accurate determination of the characteristics of radio bursts would be possible. Finally, by digitising the spectrograph's output, greater flexibility in the display, transmission and archiving of data would be achieved.

Three of the existing aerials were used in the upgrade and much of the electronics were replaced. The upgraded spectrograph sweeps a wide band of frequencies, from 18 MHz to 1.8 GHz. Two of the aerials are paraboloid dishes with cross-polarised log periodic array feeds. The remaining aerial is a dual, cross-polarised, log periodic array. Signals from each aerial initially pass into pre-amplifiers. High Q notch filters may also be included to remove known noise sources (FM radio and television transmissions).

The signals then enter the heart of the upgraded spectrograph: four spectrum analysers fitted with a GPIB bus and an extended resolution bandwidth selection. These are located in an insulated and air conditioned hut near the aerials. A PC, fitted with a GPIB card, controls all analyser functions from the observatory, some 100 metres away. Operating in single sweep mode, each analyser is assigned a different frequency band: 18-57 MHz; 57-180 MHz; 180-570 MHz; or 570-1800 MHz. The PC initiates a sweep of each analyser in sequence. One sweep consists of 512 samples, with an 8 bit amplitude resolution, and will take 0.75 seconds. Once the data are relayed to the PC they are resampled to produce a logarithmic frequency output and this is displayed in real-time on the PC's monitor and transmitted, via a local area network connection, to a workstation.

The workstation performs any further data processing required (such as noise filtering) and serves as the main display for the spectrograph. Radio flux intensity is indicated by the colour of points on a frequency verses time plot.

What Is It Used For?

IPS is concerned with predicting significant ionospheric and geomagnetic disturbances. Most, if not all, of these events derive from solar activity. Radio bursts are often emitted during such activity, in addition to the X-rays, shockwaves, protons and other charged particles which cause the disturbances. Hence, by monitoring solar radio bursts it is possible to predict other emissions which follow them and the disturbances that may result.

Radiospectrograph observations in the 1950's led to a systematic classification of solar radio bursts into five broad types. Over the years theory and observation have combined to produce a general understanding of the processes that produce these radio bursts. Although far from complete, our understanding provides us with an indication of which solar phenomena result in which radio bursts. A brief description of each of the major types of radio burst and their relevance to IPS predictions follows.

What Are The Burst Types?

Type I bursts are short, narrow band events that usually occur in great numbers together with a broader band continuum. These noise storms typically last for hours or days. On occasions the low frequency edge of the storm drifts slowly from high to low frequencies. This phenomenon is sometimes associated with eruptive prominences, which can result in geomagnetic and ionospheric storms.

Type II bursts exhibit a slow drift from high to low frequencies. They often have a double structure, exhibiting fundamental and second harmonic emissions. Their frequency drift results from the outward motion of a magnetohydrodynamic shock wave associated with the ejection of material during a solar flare. The rate of drift can be measured and used to estimate the shock speed. This gives an indication of an event's energy and, hence, the likely significance of its terrestrial effects.

Type III bursts drift rapidly from high to low frequencies. They often occur in groups of ten or more and, like type II bursts, they can exhibit a fundamental-harmonic structure. In general, these bursts are indicative of the presence of an active region on the solar disk. More importantly, large, intense, type III groups often accompany the flash phase of large flares.

Type IV events are flare-related broad-band continua. They have been divided into a variety of differing sub-classes by various authors. While confusion has resulted from this, it is clear that some of these sub-classes do correspond to different physical phenomena. For example, there is said to be a strong association between the incidence of stationary type IV's and the emission of protons but no such association with moving type IV's. These, and other sub-classes (e.g. flare continua), can all appear quite similar. Indeed, they are often only distinguishable by subtle differences in their fine structure or circular polarisation.

Type V events are broad-band continua which sometimes appear in association with type III bursts or groups. They typically last for 1 - 2 minutes, with duration increasing as frequency decreases. When a type V accompanies a type III group it can blend into the group or any following continuum making individual features difficult to discern.

Further Reading

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Prestage, N.P., Luckhurst, R.G., Paterson, B.R., Bevins, C.S., Yuile, C.G., "A New Radiospectrograph at Culgoora", Solar Physics, vol 150, page 393, 1994

Comments or suggestions about what is on the system, or what should be, can be directed to *www@ips.gov.au*

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